Section:Chemistry School: School of Science

	UNDER GRADUATE PROGRAM B. Sc. (MPC&ZBC)	
Semester	**Paper code**	**PaperTitle**
Ist	BSCH111CCT	Inorganic Chemistry-I and Organic Chemistry-I
Ist	BSCH151CCP	Inorganic Chemistry-I and Organic Chemistry-I Lab
2nd	BSCH211CCT	Organic Chemistry II & Physical Chemistry I
2nd	BSCH251CCP	Organic Chemistry II & Physical Chemistry I Lab
3rd	BSCH311CCT	Organic Chemistry III& Physical Chemistry II
3rd	BSCH351CCP	Organic Chemistry III and Physical Chemistry II Lab
4th	BSCH412CCT	Organic Chemistry IV and Physical Chemistry III
4th	BSCH452CCP	Organic Chemistry IV and Physical Chemistry III Lab
5th	BSCH502DST	Analytical Method in Chemistry
5th	BSCH551DSP	Analytical Method in Chemistry Lab
6th	BSCH603DST	Inorganic Chemistry II & Physical Chemistry IV
6th	BSCH652DSP	Inorganic Chemistry II & Physical Chemistry IV Lab

B. Sc- IstSem- (MPC and ZBC) Paper Code- BSCH111CCT

Course Title: Inorganic Chemistry I and Organic Chemistry -I

Scheme of Instruction	Scheme of Examination
Total Duration: 60 hrs.	Maximum Marks: 100
Periods/ week: 4	Internal Evaluation: 30
Credits: 4	End Semester: 70
Instruction Mode: Lecture	Exam Duration: 3 hrs.

Course Objectives: This course aims at giving students theoretical understanding about the basics of Inorganic and Organic Chemistry. It provides basic knowledge about ionic, covalent and metallic bonding and explains that chemical bonding. It discusses the periodicity in properties with reference to the s- Block Elements. The Organic Chemistry and the introduction of a concept of visualizing the organic molecules in a three-dimensional space, the functional groups, alkanes, alkenes, alkynes and aromatic hydrocarbons are included.

Course Outcomes: On successful completion, students would have clear understanding of the basics of Inorganic chemistry, Organic chemistry and concepts related to atomic and molecular structure, chemical bonding, periodic properties, Organic Reactions and Mechanisms, chemical and physical properties of alkanes, alkenes, alkynes and aromatic hydrocarbons.

Block- 1

Unit. 1.1. Periodic Classification and Periodic Properties:

Modern Periodic law**,**electronic configurations of the elements (From atomic number 1-30). Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Classification of elements on the basis of electronic configuration, Periodic trends in: atomic and ionic radii of elements, ionization energy, electron affinity and electronegativity, effective nuclear charge.

Unit 1.2 The Covalent Bond and Valence bond Approach:

Introduction to covalent bonds, Formation of molecule described using the valence bond approach, sigma and pi bonds. VSEPR model for predicting shapes of molecules and ions containing lone pairs,Theconcept of resonance in various organic and inorganic molecules, Hybridization.

Unit 1.3. Molecular Orbital Approach:

Introduction to Molecular orbital theory, LCAO method, symmetry and overlap for s-s, s-p and p-p combinations, MO treatment of homonuclear diatomic molecules of 2nd period (B_2, C_2, N_2, O_2,F_2) and heteronuclear di-atomic molecules (CO, NO) and their ions. Bond order.

Unit1.4. Physical and Chemical Forces:

Van der Waals forces, electrostatic forces, Hydrogen bonding and its applications, effects of these forces on melting point, boiling point and solubility.

Block- 2

Unit2.1 Chemistry of Alkali and Alkaline Earth Metals (s- Block Elements): 7h

General characteristics of group – I & II elements, Diagonal relationship and anomalous behaviour of an element. Position of hydrogen, hydrides and their classification (ionic, covalent and interstitial hydrides). Preparation, structure, properties and uses of hydrogen peroxide. Hardness of water. Uses of alkali. Manufacture of NaOH (by CastnerKellner method) and Na_2CO_3 (by Solvay process).Physicalandchemical properties and uses ofNaOH, Na_2CO_3.

Preparation, properties and structure of beryllium acetate. Preparation, properties and uses of calcium and magnesium compounds (Quick lime, Slaked lime, Gypsum, Plaster of Paris, Carnallite, Magnesite).

Unit2.2Boron Family: 5h

General characteristics of the boron family, Inert pair effect, Relative stability of different oxidation states. Boric acid and borates, boron nitrides, borohydrides. Diborane and its structure.

Unit 2.3 Carbon Family:

General characteristics of the carbon family, Inert pair effect, Relative stability of different oxidation states. Catenation, Allotropy, Carbides. Allotropes of carbon.

Unit 2.4 Nitrogen Family:

General characteristics of the nitrogen family, Inert pair effect, Relative stability of different oxidation states. Oxides and oxoacids of nitrogen and phosphorus. Structure of oxo-acids of phosphorous. Preparation and properties of dinitrogen. Manufacture of Ammonia by Haber process and nitric acid by Ostwald process. Chemical properties and uses of ammonia and nitric acid. Allotropes of phosphorous, Preparation, properties and uses of urea and phosphine.

Block -3

Unit 3.1 Organic Compounds:

Classification and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties

Unit 3.2Electronic Displacements:

Inductive, electomeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.

Unit 3.3 Organic Reactions and Mechanisms:

Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophilicity and basicity; Types, shape and relative stability of Carbocations, Carbanions, Free radicals and Carbenes. Introduction to different types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Unit3.4 Stereochemistry:

Isomerism- Classification of Isomerism. Structural and Stereoisomerism, Geometrical and Optical Isomerism, Concept of chirality, Enantiomersand Diastereomers, Meso compounds- Relative and absolute configuration. D and L configuration, R and S configuration of molecules withupto twocarbon atoms, E and Z configuration of geometrical isomers and Optical rotation.

Block 4

Unit 4.1 Aliphatic saturated hydrocarbons(Alkanes):

Preparations- Catalytic Hydrogenation- Wurtz Reaction- Kolbe electrolysis, Grignard Reagent.Clemmensen reduction. Substitution Reactions- Halogenation, Nitration, Sulphonation.Mechanism of halogenations of alkanes.

Unit 4.2Aliphatic-unsaturated hydrocarbons (Alkene and Alkynes):

Preparation of alkenes -Dehydration, Dehydrohalogenation (Saytzeffs Rule), Dehalogenation and Hydrogenation. Preparation of alkynes-Dehydrohalogenation, Dehalogenation, Preparation of higher members of alkynes. Addition Reactions- Addition of halogen, Addition of hydrogen acids (Markovnikov's Rule), Kharasch Effect, Hydration, Oxymercuration- Demercuration, Hydroboration- oxidation, Hydroxylation, Epoxidation, Ozonolysis, Acidic nature of alkynes- Oxidation with hot $KMnO_4$.

Unit 4.3 Aromaticity:

Huckel's rule, aromatic character of arenes, cyclic carbocations, carbanions and heterocyclic compounds with suitable examples.Polybenzenoid aromatic hydrocarbons.

Unit 4.4Aromatic compounds:

Preparation and properties of Benzene and Toluene,

Electrophilic aromatic substitution, halogenation, nitration, sulphonation and Friedel Craft alkylation, acylation with their mechanism, Directing effect of groups.

Text Books and References:

1	Concise Inorganic Chemistry by J. D. Lee ELBS, 1991
2	Inorganic Chemistry by Puri and Sharma
3	Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. Concepts & Models of Inorganic Chemistry 3rd Ed., John Wiley Sons, N.Y. 1994.
4	Cotton, F.A. & Wilkinson, G. Advanced Inorganic Chemistry, Wiley, VCH, 1999.
5	Miessler, G. L. & Donald, A. Tarr, Inorganic Chemistry, 4th Ed., Pearson, 2010.
6	Advanced Organic Chemistry by Arun Bahl and B.S.Bahl
7	Organic Chemistry by RT Morrison and R.N.Boyd
8	Organic Chemistry by T.W.Graham Solomon, C.B.Fryhle and S.A.Dnyden
9	Organic Chemistry Volume I &II by I.L.Finar
10	Advanced Organic Chemistry by Jerry March

B. Sc. Ist Semester

Course Title: Inorganic Chemistry -I and Organic Chemistry -I Lab

Course code: BSCH151CCP

Scheme of Instruction	Scheme of Examination
Total Duration: 60 hrs.	Maximum Marks: 50
Periods/ week: 4	Internal Evaluation: 15
Credits: 2	End Semester: 35
Instruction Mode: Lecture/Demonstration	Exam Duration: 3 hrs.

Course Objective:

Basically, there are two types of studies are done in the laboratory - a) Qualitative analysis b) Quantitative analysis. This paper has two blocks and each block has 4 experiments.

First block , basically concerned with Quantitative analysis under which preparation of standard solutions of different salts/ compounds and calculation of concentration of unknown solution by titration method using different solution of known concentration.

Second block, is basically concerned with qualitative analysis in which i) detection of specific elements like nitrogen, sulphur, halogen (Chlorine, bromine and iodine) present in organic compound, ii) identification of function group in an organic compounds iii) separation of metal cations from their mixture using paper chromatographic technique and iv) identification of biomolecules present in organic compounds.

Course Outcomes: On the completion and performing all the experiments

In Ist block, students will be able to know the idea of quantitative analysis. Moreover, the students will learn the knowledge and idea of i) how to standard solutions are prepared of different concentration and ii) able to calculate the concentration of unknown solution of by titration method.

In block IInd , the students will be aware about the concept of qualitative analysis . By qualitative analysis, the students would be able i) how are the specific elements are detected ii) the presence of functional group in unknown organic compounds using different specific

analytical reagents. Moreover, the students will also learn about the chromatographic technique which is very essential technique in the separation science. Apart from all these, the students will be able to analysis the presence of biomolecules like carbohydrate, fats, proteins in the given organic compound.

Block- I

1. Preparation of standard solution of Sodium Carbonate and standardization and estimation of HCl using it .
2. Preparation of standard solution of Oxalic Acid and standardization and estimation of NaOH using it .
3. Preparation of standard solution of Mohr's salt, standardization of KMnO4 with it and estimation of Mohr's salt
4. Preparation of standard solution of Potassium Dichromate and estimation of ferrous iron using it.

Block II

1. Preparation of sodium fusion extract and using it identify nitrogen, sulphur, both sulphur and nitrogen and halogens in the given organic compound
2. Identification of function group(alcoholic, carboxylic, phenolic, aldehyde and ketone) in the given organic compound
3. Separation of metal cations from their mixture using paper chromatographic technique
4. Identification of carbohydrate, fats, proteins in the given organic compound.

Text Books and References:

1	Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)
2	Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).

B. Sc- IInd Sem- (MPC and ZBC) Paper Code- BSCH211CCT

Course Title: Organic Chemistry II and Physical Chemistry I

Scheme of Instruction	Scheme of Examination
Total Duration: 60 hrs.	Maximum Marks: 100
Periods/ week: 4	Internal Evaluation: 30
Credits: 4	End Semester: 70
Instruction Mode: Lecture	Exam Duration: 3 hrs.

Course Objectives: This course contains Alkyl halides, Aryl halides, Alcohols, Phenols, ethers, Epoxides, and Organometallic compounds and various reactions involving Nucleophilic substitution reaction. It provides basic information about the classification, preparation and applications. A detailed unit of chemistry of solutions and various Gas laws and theories.

Course Outcomes: On successful completion, students would have clear understanding of the chemical and physical properties of Alkyl halides, Aryl halides, and Organometallic compounds and its applications. Learn and apply Nucleophilic substitution reactions in preparation of various organic reactions. Understand the fundamental concepts of Solutions, and gases.

Block I

Unit- 1.1 Alkyl halides:

Introduction to alkyl halide, Classification of Alkyl Halide: Methods of preparation, Physical properties of alkyl halide and uses of alkyl halides.

Unit- 1.2 Nucleophilic substitution reaction:

Introduction to nucleophilic substitution reaction, Types of substitution reaction, $SN_1$and SN_2 mechanisms with Stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs elimination.

Unit- 1.3 Aryl halides:

Preparation, including preparation from diazonium salts, nucleophilic aromatic substitution, Benzyne mechanism. Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

Unit- 1.4 Organometallic compounds:

Introduction to Organometallic compounds, Classification of Organometallic compounds, Organometallic compounds of Mg – Applications of Grignard reagents in synthesis of organic compounds like alkane, alcohols, aldehydes, ketones, carboxylic acids.

Block II

Unit- 2.1Alcohols:

Introduction to alcohols, preparation, properties and relative reactivity of 1°, 2°, 3°alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement

Unit- 2.2 Phenols:

Preparation and properties; Acidity and factors affecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements with mechanism

Unit- 2.3 Ethers:

Introduction to ethers, Classification of ethers, Preparations of symmetric and unsymmetric ethers, Physical and chemical properties, uses of ethers.

Unit- 2.4 Epoxides:

Introduction to epoxides, Reactions of epoxides with alcohols, ammonia derivatives and $LiAlH_4$.

Block III

Unit- 3.1 Chemistry of solution – I:

Classification of solution, Concentration terms and its units, Solutions of a gas in a liquid, Solubility of a gas in a liquid – Henry's Law and deviation, Effect of heat, Solutions of a liquid in a liquid, Raoul's Law, Deviation from Raoul's Law, Vapor pressure- composition, Temperature- composition curves and their explanation for an Ideal and non- ideal solution, Solutions of a solid in a liquid,

Completely miscible liquid mixtures – Ideal solutions and Raoul's Law – Deviations from Raoul's law – non-Ideal solutions – Vapor pressure composition and temperature composition curves of ideal and non-ideal solutions -Distillation of solutions – Theory of fractional distillation

Unit- 3.2 Chemistry of solution – II:

Vapor pressure of liquid, Partial vapor pressure in binary solution, Distillation of homogenous binary mixture, Separation of pure components in liquid mixture. Fractional distillation, partially miscible liquid mixtures, Critical solution temperature with reference to Phenol -Water System, Triethyl amine - water system and Nicotine -Water system and effect of temperature, Nernst Distribution law and its application in solvent extraction – principle of steam distillation and its utility.

Unit- 3.3 Colligative properties – I:

Vapor pressure of liquid, Lowering of Vapor pressure – Relative lowering in vapor pressure, Raoul's Law – Determination of relative lowering in vapor pressure, Determination of molecular mass of non- volatile solute. Osmosis and Osmotic Pressure – Laws of Osmotic Pressure, Measurement of osmotic pressure, Numerical problem based on osmotic pressure. Isotonic solution, Abnormal behaviour of solution, non-ideal solution, Reason for abnormal behaviour of non- ideal solution, Relation between osmotic pressure and vapor pressure.

Unit- 3.4 Colligative properties – II:

Vapor pressure of liquid, boiling point and freezing point, Elevation in boiling point, Relation between molecular mass of non- volatile solute and elevation in boiling point, Methods of experimental determination of elevation in boiling point, Methods of determination of depression in freezing points, Degree of dissociation and association of solute, Abnormal molecular mass, Van's Hoff equation, Van's Hoff factor.

Block IV

Unit- 4.1 Brief review of the Gas Laws:

Measurable properties of gases, Gas laws, Boyle's law, Charle's law, Gay Lusac law, Avogadro's law, Ideal gas equation, Combined gas equation, Relation between molecular mass and density of gas, Compressibility factor, Dimensions of gas constant (R), Values of gas constant (R) in different units, Boltzmannconstant, Graham's law of Diffusion, Dalton's law of partial pressure

Unit- 4.2 Kinetic Molecular Theory of Gases:

Kinetic theory of gases, Important postulates of kinetic theory of gases, Derivation of kinetic gas equation, Deduction of gas laws from kinetic gas equation, Maxwell's distribution of molecular velocity (average velocity, root mean square velocity and most probable velocity). Average kinetic energy, Law of equipartition of energy, Degrees of freedom and molecular basis of heat capacities.

Unit- 4.3 Behaviour of Real Gases:

Deviation from ideal gas behaviour, compressibility factor (Z) and its variation with pressure for different gases, causes of deviation from ideal gas behaviour, Van-der Waals equation of state, pressure correction, volume correction, Van der Waal's equation and its derivation, Van-der Waal's constants and their units, Suitability of Van der Waal's equation. Other equations of state (Berthelot, dieterici and virial equations), Boyle temperature.

Unit- 4.4 Critical phenomenon:

Critical phenomenon, Continuity of state, Critical state, Andrews experiments on carbon dioxide, Derivation of relation between critical constants and Van der Waal constants, Law of corresponding states.

Text Books and References:

1	Advanced Organic Chemistry by Arun Bahl and B.S.Bahl
2	Organic Chemistry by RT Morrison and R.N.Boyd
3	Organic Chemistry by T.W.Graham Solomon, C.B.Fryhle and S.A.Dnyden
4	Organic Chemistry Volume I &II by I.L.Finar
5	Advanced Organic Chemistry by Jerry March
6	Essentials of Physical Chemistry by B.S.Bahl and G.D.Tuli
7	Principles of Physical Chemistry by B.R.Puri and L.R.Sharma
8	Textbook of Physical Chemistry by S.Glasstone
9	Elements of Physical Chemistry by S.Glasstone
10	Principles of Physical Chemistry by Maron and Prutton
11	Elements of Physical Chemistry by P.W.Atkins
12	Advanced Physical Chemistry by Gurdeep Raj

Semester II

Course Title: **Organic Chemistry -II and Physical Chemistry-I Lab**

Course Code: BSCH251CCP

Scheme of Instruction	Scheme of Examination
Total Duration: 60 hrs.	Maximum Marks: 50
Periods/ week: 4	Internal Evaluation: 15
Credits: 2	End Semester: 35
Instruction Mode: Lecture /Demonstration	Exam Duration: 3 hrs.

Course Objectives: Basically, there are two types of studies are done in the laboratory - a) Qualitative analysis b) Quantitative analysis. This paper has two blocks and each block has 4 experiments.

First block , basically concerned with both qualitative and quantitative analysis. In qualitative analysis, the identification and confirmation of simple organic compounds are studied where as in quantitative analysis, preparation of different organic compounds and their characterization like purification by different methods (Distillation and recrystallisation) and determination of melting point of the organic compound is studied.

Second block, is basically concerned with quantitative analysis in which the following experiments are under study: i) Determination of molecular mass of a non-volatile solute by Rast method ii) Determination of the relative and absolute viscosity of a liquid or dilute solution using Ostwald's viscometer iii) Determination of distribution coefficient of benzoic acid between benzene and water. iv) Determination of the surface tension of a liquid or a dilute solution using stalagmometer.

Course Outcomes: On the completion and performing all the experiments as reported in first and second block, the following outcomes can be drawn.

a) In Ist block, students will be able to know the idea of both qualitative and quantitative analysis. Moreover, the students will learn the knowledge and idea of i) how to

organic compounds are prepared ii) how to organic compounds purified iii) able to understand the method to determine the melting point of that compound

1. In block IInd , the students will be aware about the concept of quantitative analysis and will be aware and understand : i) how is molecular mass of a non-volatile solute calculated by Rast method ii) how is the relative and absolute viscosity of a liquid or dilute solution with the help of Ostwald's viscometer iii) how is distribution coefficient of benzoic acid between benzene and water determined .and iv) how is surface tension of a liquid or a dilute solution using stalagmometer determined.

Block- I

1. Identification and confirmation of simple organic compound (ethanol, acetaldehyde, acetone, acetic acid, benzoic acid and phenol)
2. Preparation of Organic compounds (aspirin and picric acid)
3. Purification of organic compounds by i) Distillation Process ii) Recrystallisation Process
4. Determination of melting and boiling points of organic compounds

Block –II

2. Determination of molecular mass of a non-volatile solute by Rast method
3. Determination of the relative and absolute viscosity of a liquid or dilute solution using Ostwald's viscometer
4. Determination of distribution coefficient of benzoic acid between benzene and water.
5. Determination of the surface tension of a liquid or a dilute solution using stalagmometer.

Text Books and References:

1	Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)
2	Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).

B. Sc- IIIrdSem- (MPC and ZBC) Paper Code- BSCH311CCT

Course Title: Organic Chemistry III and Physical Chemistry II

Scheme of Instruction	Scheme of Examination
Total Duration: 60 hrs.	Maximum Marks: 100
Periods/ week: 4	Internal Evaluation: 30
Credits: 4	End Semester: 70
Instruction Mode: Lecture	Exam Duration: 3 hrs.

Course Objectives: This course contains biomolecules including Carbohydrates, Amino Acids, Peptides, proteins, Nucleic Acid, lipids and Polymers. It imparts adequate knowledgeable information on thermodynamics and thermochemistry and Chemical and Ionic-Equilibria.

Course Outcomes: On successful completion, students would have clear understanding of the biomolecules and its synthesis and application and detailed understanding about polymers. Understand the fundamental concepts of Thermodynamics and Thermochemistry and Chemical and Ionic- Equilibria.

Block- I Biomolecules:

Unit- 1.1 Carbohydrates:

Introduction, Classification of carbohydrates, Reducing and non- reducing sugars, General properties of glucose and fructose, their open chain structure. Epimers, anomers and muta rotation. Determination of configuration of glucose (Fischer proof). Cyclic structure of glucoseand fructose (Haworth projections). Chain lengthening and chain shortening of aldoses. Elementary idea of structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose)

Unit- 1.2 Amino Acids, Peptides and Proteins:

Classification of Amino Acids, Physical and chemical properties of amino acids, Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Determination of primary structure of peptides, determination of N-terminal amino acid (by DNFB and Edman method) and C–terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme)

Unit- 1.3 Nucleic Acids:

Components of Nucleic acids: Adenine, guanine, thymine and cytosine (structure only) Nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic code, biological roles of DNA and RNA: Replication, Transcription and Translation.

Unit 1.4 Lipids:

Introduction to lipids, classification. Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats, Hydrogenation, Saponification value, Iodine number. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).

Block –II Polymers:

Unit- 2.1 Addition and condensation polymers:

Introduction, how are polymers classified? Classification of polymers on the basis of intermolecular forces and on the basis of synthesis, Addition and condensation polymers, Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerization of alkenes

Unit- 2.2 Plastics:

Introduction, types of plastics**,** difference between thermoplastic and thermosetting plastics**,** Preparation and applications of plastics – thermosetting (Bakelite, melamine, Polyurethanes) and thermoplastic (PVC, polythene, Teflon, polystyrene, PMMA)

Unit-2.3 Fibers and Rubbers:

Introduction, types of fibers**,** natural and synthetic fibers Preparation, properties and applications of synthetic fibers (acrylic, polyamide, polyester); Introduction, types of rubbers, natural and synthetic: Preparation, properties and applications of synthetic rubber (Buna-S, Buna – N, Chloroprene and Neoprene), Vulcanization

Unit- 2.4 Biodegradable polymers:

Introduction, Types of biodegradable polymers, Preparation, properties and its applications. conducting polymers with examples. Properties of polymers, Number average molecular weight, Weight average molecular weight, Polydispersity index, Degree of polymerization

Block – III Thermodynamics and Thermochemistry:

Unit- 3.1 First law of thermodynamics:

Brief review of thermodynamic terms – system, surroundings, closed system, open system, isolated system. Thermodynamic process- isothermal process, adiabatic process, Reversible process, Irreversible process, cyclic process. work, heat, temperature, zeroth law of thermodynamic, law of conservation of energy, Internal energy – Enthalpy – First law of thermodynamics – Various statements – Mathematical formulation of First law of thermodynamics, Derivation of equation for maximum work done in the reversible isothermal expansion of an ideal gas. – molar heat capacity at constant pressure (C_p) and at constant volume (C_v). Derivation of relationship between them, Joule Thomson effect. Inversion temperature, Boyle's temperature.

Unit- 3.2 Thermochemistry:

Exothermic and endothermic reactions, Examples of thermo-chemical equations, Concept of standard state, standard enthalpies of formation, integral and differential enthalpies of

solution and dilution, heat of combustion and its determination by bomb calorimeter method, heat of neutralization, heat of reaction at constant pressure (H) and at constant volume (E) and the relation between them, Hess's law of constant heat summation and its applications, calculation of bond energy and bond dissociation energy from thermochemical data, variation of enthalpy of a reaction with temperature (Kirchhoff's equations) , calculation of heats of reaction from bond energies.

Unit 3.3 The second Law of Thermodynamics:

Need for the second law of thermodynamics, Spontaneous and non- spontaneous process, Conversion of heat into work. Statement of second law of thermodynamics in its various forms – Concept of Entropy, entropy and second law.The Carnot's Cycle - Derivation of an equation for the thermodynamic efficiency of a Carnot's engine. Molecular interpretation of entropy, Entropy and disorder.

Unit- 3.4 (A) FREE- ENERGY AND WORK FUNCTION:

Physical interpretation of free energy (Gibb's Free energy) – Helmholtz Free energy, Gibb's Free energy and Helmholtz Free energy relationship, – Derivation of Gibb's-Helmholtz equation – Maxwell thermodynamic relation.

(B) The Third Law of Thermodynamics:

Development of third law of thermodynamics, Entropies with reference to absolute zero,statement, Applications of third law of thermodynamics to the calculations of absolute entropies of substances(solid, liquid and gas) test of the third law of thermodynamics. – Statement - Calculation of Absolute Entropies of substances.

Block – IV Chemical and Ionic- Equilibria

Unit- 4.1 Chemical Equilibrium:

Reversible reactions- Homogeneous and heterogeneous, gaseous reversible and irreversible reactions, Dynamic nature of chemical equilibrium, Characteristics of chemical equilibrium. Law of mass action, Characteristics of equilibrium constant, equilibrium constant in terms of partial pressure (K_p) and in terms of molar concentration (K_C), Derivation of relation between K_P and K_C – Applications of Law of mass action. Chemical equilibrium constant expression for some reactions:

i) $H_2\,(g) + I_2\,(g) \rightleftharpoons 2HI\,(g)$ ii)$2SO_2\,(g) + O_2\,(g) \rightleftharpoons 2SO_3\,(g)$iii) $PCl_5\,(g) \rightleftharpoons PCl_3\,(s) + Cl_2\,(g)$ iv) $N_2(g) + 3H_2\,(g) \rightleftharpoons 2NH_3\,(g)$

Unit- 4.2 Le- Chatelier's Principle:

Statement and explanation of Le Chatlier's Principle – Effect of concentration, pressure and temperature on the equilibrium state of some equations. Application of Le-Chatelier's Principle to: i) $H_2\,(g) + I_2\,(g) \rightleftharpoons 2HI\,(g)$ii) $2SO_2\,(g) + O_2\,(g) \rightleftharpoons 2SO_3\,(g)$iii) $PCl_5\,(g) \rightleftharpoons PCl_3\,(s) + Cl_2\,(g)$ iv) $N_2(g) + 3H_2\,(g) \rightleftharpoons 2NH_3\,(g)$. Application of Le-Chatelier's Principle to some physical equilibria, calculations of degree of dissociation from density measurement.

Unit- 4.3 Ionic- Equilibrium:

Strong and weak electrolytes – Degree of ionization – Factors affecting degree of ionization – Ionization constant - Derivation of Ostwald's Dilution law – Ionic product of water – Ionization of weak acids and bases, Common Ion effect – Solubility product, Application of solubility product in purification of common salts and salting out of soap, qualitative inorganic analysis.

Unit- 4.4 Buffer Solutions and Salt Hydrolysis:

Ionic- Product of Water, Hydrogen ion concentration, pH scale, pH of weak acids and bases. Buffer solutions, types of buffer solution, mechanism of buffer action, buffer capacity. Derivation of Henderson's Equation for a buffer mixture. Salt Hydrolysis - Types of salt hydrolysis, derivation of relation between hydrolysis constant and degree of hydrolysis and

expression of pH of different salts. Solubility and solubility product of sparingly soluble salts. Application of solubility product in chemical analysis.

Text Books and References:

1	Essentials of Physical Chemistry by B.S.Bahl and G.D.Tuli
2	Principles of Physical Chemistry by B.R.Puri and L.R.Sharma
3	Textbook of Physical Chemistry by S.Glasstone
4	Elements of Physical Chemistry by S.Glasstone
5	Principles of Physical Chemistry by Maron and Prutton
6	Elements of Physical Chemistry by P.W.Atkins
7	Advanced Physical Chemistry by Gurdeep Raj
8	Advanced Organic Chemistry by Arun Bahl and B.S.Bahl
9	Organic Chemistry by RT Morrison and R.N.Boyd
10	Organic Chemistry Volume I &II by I. L. Finar
11	Principles of Biochemistry by Lehninger's, Nelson, D. L. & Cox, M. M. 7th Ed., W. H. Freeman
12	Biochemistry by Berg, J. M., Tymoczko, J. L. & Stryer, L. 7th Ed., W. H. Freeman.

Semester-IIIrd

Course Title: Organic Chemistry -III and Physical Chemistry -II Lab

Course Code: BSCH351CCP

Scheme of Instruction	Scheme of Examination
Total Duration: 60 hrs.	Maximum Marks: 50
Periods/ week: 4	Internal Evaluation: 15
Credits: 2	End Semester: 35
Instruction Mode: Lecture /Demonstration	Exam Duration: 3 hrs.

Course Objectives: To train the students about separation of organic compounds by Thin-layer Chromatographic Technique, determination of saponification values of different oil and fats, preparation of polymer, use of pH metric methods of analysis for determination of pH and strength of strong acid by pH metric titration,calorimetric determination of heat capacity.

Course Outcomes: At the end of the course the students will understand separation techniques and how to handle the pH meter and to measure the pH of the unknown soliton, calorimetric Measurement.

Block- I

1. Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by thin layer chromatography. Reporting the R_F values

2. Determination of the saponification value of fats and oils
3. Preparation of Phenol formaldehyde resin (Bakelite)
4. Preparation of urea-formaldehyde resin

Block –II

1. Determination of heat capacity of a calorimeter
2. Determination of heat of neutralization of Hydrochloric Acid with Sodium Hydroxide
3. Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps using pH-meter
4. Determination of strength of strong acid (HCl) by pH metric titration with strong base (NaOH)

Text Books and References:

1	Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
2	Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)
3	Ahluwalia, V.K.; Dhingra, S. (2004), Comprehensive Practical Organic Chemistry: QualitativeAnalysis, University Press.
4	Seymour/ Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr. (2013)
5	B.D. Khosla: Senior Practical Physical Chemistry, R. Chand & Co.
6	A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall
7	Practical Chemistry, OP Pandey, DN Bajpai, S. Giri, S. Chand & Company Ltd., 2008

B. Sc- IVth Sem- (MPC and ZBC) Paper Code- BSCH412CCT

Course Title: Organic Chemistry IV and Physical Chemistry III

Scheme of Instruction	Scheme of Examination
Total Duration: 60 hrs.	Maximum Marks: 100
Periods/ week: 4	Internal Evaluation: 30
Credits: 4	End Semester: 70
Instruction Mode: Lecture	Exam Duration: 3 hrs.

Course Objectives: students to be benefited from the study of the preparation, reactions and the mechanistic aspects of carbonyl compounds, carboxylic acids, their derivates and nitrogen compounds such as nitro, nitriles, isonitriles, amines and diazonium compounds. Further to introduce the various concepts and applications of electrochemistry, colloids and surfaces

Course Outcome: On successful completion, students would have clear understanding of the carbonyl compounds, carboxylic acids, their derivates and nitrogen compounds such as nitro, nitriles, isonitriles, amines and diazonium compounds, electrochemistry, colloids and surfaces

Block- I Carbonyl compounds

Unit-1.1 Aldehydes and Ketones:

Introduction, Nomenclature of carbonyl compounds, General methods of preparations and physical properties of carbonyl compounds, Reactivity of carbonyl compounds, Uses of aldehydes and ketones.

Unit 1.2 Nucleophilic Addition Reactions:

Nucleophilic addition reactions, Examples of nucleophilic addition reactions and their mechanism. Nucleophilic addition-elimination reactions with ammonia derivatives and also their mechanism.

Unit- 1.3 Mechanism of Some name Reactions:

Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann rearrangement, Addition reactions of unsaturated carbonyl compounds: Michael addition

Unit-1.4 Oxidation and Reduction of aldehydes and ketones:

Oxidation and reduction of carbonyl compounds, haloform reaction and Baeyer Villiger oxidation, Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, MPV, PDC and PGC, α-substitution reactions,

Block – II Carboxylic Acids and their Derivatives, Nitrogen containing compounds

Unit- 2.1 Carboxylic Acids:

Introduction, Nomenclature of monocarboxylic acid, Preparation and properties of monocarboxylic acids. Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group. Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann condensation.

Unit- 2.2 Dicarboxylic acids and Active Methylene Compounds:

Introduction, Nomenclature of dicarboxylic acids, Preparation and properties of succinic/phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids. Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate

Unit- 2.3 Amines:

Introduction, Classification of amines, nomenclature of amines. Preparation and properties of amines (Gabriel phthalimide synthesis, Carbylamine reaction, Mannich

reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction), Distinction between 1°, 2°and 3°amines with Heinsberg reagent and nitrous acid. Effect of substituent and solvent on basicity.

Unit- 2.4 Nitro compounds, nitriles, isonitriles and Diazonium salts:

Introduction, preparation and properties of nitro compounds, nitriles and isonitriles. Preparation and synthetic applications of diazonium salts

Block- III

Unit- 3.1 Oxidation-Reduction:

Concept of oxidation and reduction (old and modern concepts). Oxidation number, Rules for calculating oxidation number in different types of elements. Difference between valency and oxidation number. Balancing of redox reaction in acidic and basic medium by oxidation and ion electron method. Disproportionation reaction, Auto-oxidation, formal charge, stoichiometry of redox reactions in solution.

Unit-3.2 Electrolytes and Electrolysis:

Introduction, metallic or electronic conductors, electrolytic conductors, Distinction between metallic and electrolytic conductors**.** Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry.

Unit-3.3 Reversible Electrodes:

Types of reversible electrodes- Electrodes of the first kind (metal-metal ion electrodes), the gas electrode, metal-in soluble salt. Redox electrodes. Electrode reactions, Oxidation half-cell and reduction half-cell reactions, Representation of a cell. Nernst equation, single electrode potential, standard or normal hydrogen electrode (SHE OR NHE), reference electrodes, calomel electrode, standard electrode potential, sign convention, electrochemical series and its significance.

Unit-3.4 Galvanic cells and EMF:

Reversible and irreversible cells, Electrochemical cells. Electrolytic cells, Galvanic or Voltaic cells, Daniel cells, Salt bridge and its significance. Determination of standard electrode potentialof an electrode. EMF of Galvanic cell and its measurements. Computation of cell EMF. Applications of EMF measurements, Calculation of

thermodynamic quantities of cell reactions (ΔG, ΔH and K). Determination of pH using quinhydrone electrode, Solubility product of AgCl. Potentiometric titrations – qualitative treatment (acid – base and oxidation – reduction only).

Block- IV Surface Chemistry and Colloids:

Unit- 4.1 Adsorption:

Adsorption, Absorption, Difference between adsorption and absorption. Adsorbate and adsorbent. Mechanism of adsorption, Types of Adsorptions. Physical adsorption, chemisorption, difference between physisorption and chemisorption, Adsorption isotherms and adsorption isobar. Factors affecting adsorption. Applications of adsorption.

Unit- 4.2 Colloids, types and preparation:

Definition, Classification, Lyophilic and Lyophobic Colloids, Solids in liquids (sols)-preparation of lyophobic sol and Preparation of lyophilic sol by physical methods (Electrical dispersion method and Peptization) Condensation Method(By oxidation, Reduction, hydrolysis methods by double decomposition, by exchange of solvents and by excessive cooling).

Unit- 4.3 Purification, properties and stability of colloids:

Different methods of purification (Dialysis, electrodialysis and ultrafiltration), General properties of colloidal solution (Mechanical, Optical and electrical properties), Stability of colloids, Protective colloids, Hardy-Schulze law, protection of colloids, gold number with examples.

Unit-4.4. Coagulation, Emulsion and application of colloids

Coagulation of colloids, origin of charge on colloidal particles, Emulsion, Types of emulsion, preparation, properties of emulsion and uses.Elementary idea of gels, Applications of colloids.

Text Books and References:

1	Advanced Organic Chemistry by Arun Bahl and B.S.Bahl
2	Organic Chemistry by RT Morrison and R.N.Boyd
3	Organic Chemistry by T.W.Graham Solomon, C.B.Fryhleand S.A.Dnyden
4	Organic Chemistry Volume I &II by I.L.Finar
5	Advanced Organic Chemistry by Jerry March
6	Essentials of Physical Chemistry by B.S.Bahl and G.D.Tuli
7	Principles of Physical Chemistry by B.R.Puri and L.R.Sharma
8	Textbook of Physical Chemistry by S.Glasstone
9	Elements of Physical Chemistry by S.Glasstone
10	Principles of Physical Chemistry by Maron and Prutton
11	Elements of Physical Chemistry by P.W.Atkins
12	Advanced Physical Chemistry by Gurdeep Raj

Course Code: BSCH452CCP **Semester-IV**

Course Title: ORGANIC CHEMISTRY-III AND PHYSICAL CHEMISTRY-III Lab

Scheme of Instruction	Scheme of Examination
Total Duration: 60 hrs.	Maximum Marks: 50
Periods/ week: 4	Internal Evaluation: 15
Credits: 2	End Semester: 35
Instruction Mode: Lecture /Demonstration	Exam Duration: 3 hrs.

Course Objectives: To train the students about how to Prepare benzoic acid, nitro benzene, Acetanilide, Para bromo acetanilide. It also provides hands on experience for the colorimetric determination of ferric iron, composition of ferric thiocyanate complex, Conductometric and Potentiometric titrations

Course Outcomes: On successful completion, students would have clear understanding of the preparation of benzoic acid, nitro benzene, Acetanilide, Para bromo acetanilide. They will also learn about colorimetric, conductometric and potentiometric measurement

BLOCK-I

1. Preparation of Benzoic acid.
2. Preparation of Nitro benzene.
3. Preparation of Acetanilide.
4. Preparation of para bromo acetanilide.

BLOCK-II

1. Study the adsorption of Oxalic Acid from its aqueous solution on activated Charcoal and verify the Freundlich and Langmuir isotherms
2. Determination of strength of strong acid (HCl) by conductometric titration with strong base (NaOH)
3. Determination of strength of weak acid (CH_3COOH) by conductometric titration with strong base (NaOH)
4. Determination of strength of strong acid (HCl) by Potentiometric titration with strong base (NaOH)

Text Books and References:

1	Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
2	Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)
3	Ahluwalia, V.K. &Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).
4	Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003)
5	Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
6	A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall
7	Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003)

B. Sc- V Sem- (MPC and ZBC) Paper Code- BSCH502DST

Course Title: Analytical Method in Chemistry

Scheme of Instruction	Scheme of Examination
Total Duration: 60 hrs.	Maximum Marks: 100
Periods/ week: 4	Internal Evaluation: 30
Credits: 4	End Semester: 70
Instruction Mode: Lecture	Exam Duration: 3 hrs.

Course Objectives: To kindle confidence in students for better understanding of basic concepts of classical and modern analytical methods of chemical analysis as well as to keep abreast with developments of recent techniques of analysis.

Outcomes:

The knowledge of fundamental principles of each analytical method of analysis with possible applications will induce great confidence among students to utilize different analytical techniques in chemical analysis.

Block-I Analytical Chemistry and Statistical Analysis of Analytical Data

Unit 1.1 Scope and Importance of Analytical Chemistry:

Introduction to analytical Chemistry, importance in various fields of science i.e., pharmacy, agriculture, environment, medical technology. Chemical analysis: Qualitative analysis,

Quantitative analysis; major, minor and trace constituents. Quantitative methods of analysis-classification of analytical methods according to property- parameter measured, size of the sample with explanation. Steps in typical quantitative analysis. Types of analysis – Complete analysis, partial analysis and assay of ingredients, the analytical chemist and analyst.

Unit 1.2 Sampling & Data handling:

Types of samples, Preparation of sample for analysis, sample treatment, moisture in sample, decomposition of organic & inorganic compounds, procedure of sampling of solids, liquids and gases. Collection, arrangement and analysis of analytical data. Types of data – qualitative and quantitative. Data collection methods – primary and secondary data, advantages and disadvantages of primary and secondary data, difference between primary and secondary data

Unit 1.3 Errors in Chemical Analysis:

Types and sources of errors of analytical data, determinate and indeterminate errors-operational and personal errors, instrumental and reagent errors, errors of methods, additive or proportional errors. Minimization of systematic (determinate errors) – calibration of apparatus and application of correction, running blank determination, running a control determination, use of independent methods of analysis, standard addition, isotopic dilution. Absolute and relative errors. Normal (or Gaussian error cure)

Unit 1.4 Statistical Treatment of Analytical Data:

accuracy and precision, statistical terms (mean, median, mode, mean deviation, standard deviation and variance). Significant figures and propagation of errors. Confidence limit, Test of significance – the F-test and T-test. The statistical Q-test for rejection of a result, Criteria of validity or rejection of result. Problem based on mean, median, mode, mean deviation and standard deviation.

Block-II Spectroscopy

Unit 2.1 UV- Visible spectrometry:

Interaction of radiation with matter and types of electron transitions. Chromophores and auxochrome groups. UV- Visible spectrometry: Validity of Beer- Lambert's law. Basic principles of instrumentation (choice of source, monochromator and detector), Single and double beam instruments. Application in quantitative analysis, estimation of metal ions from

aqueous solution, geometrical isomers, determination of composition of metal complexes using Job's method of continuous variation and mole ratio methods. Deviation from Beer's law

Unit 2.2 IR Spectroscopy:

Infrared spectrometry; basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instruments, sampling techniques. Structural illustration through interpretation of data, effect of hydrogen bonding

Unit 2.3 Atomic Absorption Spectroscopy (AAS):

Principles of AAS, Instrumentation – flame AAS and furnace AAS, resonance line sources, sensitivity and detection limits in AAS, interferences –chemical and spectral, evaluation methods in AAS and applications in qualitative and quantitative analysis.

Unit 2.4 Atomic Emission Spectroscopy (AES):

Principle of AES, Instrumentation, Interferences, evaluation methods, Application in quantitative analysis.

Block-III Thermal and Electroanalytical methods

Unit 3.1 Thermal methods – I:

Introduction and classification of thermoanalytical methods; thermogravimetric analysis (TGA): definition, types of TGA, basic principle of instrumentation, Theory of thermogravimetry (TG). TGA curve, factors affecting TGA curves, calculation of percent decomposition and composition of compounds; limitation and advantages of TGA; application of TGA to the thermal behavior including crystalline copper sulphate, calcium oxalate monohydrate, zinc hexafluoro silicate; Techniques for quantitative estimation of Ca and Mg from their mixture

Unit 3.2 Thermal methods – II:

Differential thermal analysis (DTA): definition, theoretical basis of DTA, instrumentation, factors affecting the DTA curve, application of DTA, advantages and disadvantages of DTA; differential scanning calorimetry (DSC): Definition, comparison of DTA and DSC techniques, instrumentation, factors affecting DSC curves.

Unit 3.3 Electroanalytical methods-I:

Classification of Electroanalytical Methods, Potentiometry: Metal electrodes for measuring the metal's cation, metal-metal salt electrodes, redox electrodes, calomel electrode, measurement of potential, determination of concentrations, residual liquid-junction potential, accuracy on direct potentiometric, glass pH electrode, ion-selective electrodes Basic Principle of Potentiometry, Potentiometric Titrations,

pH metry: Basic Principle of pH Metric Titration, Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values

Conductometry: Basic Principle of Conductometry, Conductometric Titrations, Applications of Conductometry.

Unit 3.4 Electroanalytical methods-II:

Voltammetry: Voltammetric principles, hydrodynamic voltammetry, stripping voltammetry, cyclic voltammetry, criteria of reversibility of electrochemical reactions, quasi-reversible and irreversible processes, qualitative and quantitative analysis,

Polarography: Principles, classification of polarographic techniques, types of polarographic currents, instrumentation, factors affecting polarographic wave, pulse polarography, and differential pulse polarograph.

Block-IV Chromatography

Unit 4.1 General Aspects of Chromatography:

Introduction, general description of chromatography, Elution chromatography; Classification of chromatographic methods- based on types of stationary and liquid phase, equilibria involved and planes; Migration rates of solutes- partition coefficient, retention time & volume, capacity factor, selectivity factor

Unit 4.2 Paper chromatography:

Experimental modifications, various modes of development, nature of the paper, detection of spots, retardation factors, factors that affect the reproducibility of R_f values (due to paper, solvent system, sample, development procedure), selection of solvent, quantitative analysis. Applications

Unit 4.3 Thin layer chromatography:

Stationary phase, adsorbents, liquid phase supports, plate preparation, mobile phase, sample application, development, saturation of chamber, detection of spot, R_f values (effect of adsorbent, solvent, solute, development process), quantitative analysis, applications

Unit 4.4 Gas Chromatography and HPLC

Basic Concepts of Gas Chromatography and HPLC, Instrumentation: Stationary and Mobile Phases, Application

Text Books and References:

1	Quantitative Analysis, 6th Ed. R.A. Day Jr. and A.L. Underwood. Prentice Hall India Ltd. 1991.
2	Analytical Chemistry, 6th Ed. G.D. Christian, Jhon Wiley & Sons (Asia) Pvt. Ltd., New Delhi, 2004
3	Vogel's Text Book of Quantitative Chemical Analysis, 6th Ed. J. Mendham, R.C. Denney, J.D. Barnes, M.J.K. Thomas, Pearson Education Ltd. 2000
4	Fundamental of Analytical Chemistry, 9th Ed. D.A. Skoog, D.M. west, F.J. Holler, S.R. Crouch, Brooks Cole – Cengage Learning 2014
5	Chemical Analysis, Modern Instrumental Methods and Techniques, 2nd Ed. Francis Rouessac, Annick Rouessac, Wiley 2007.
6	G.W. Ewing, Instrumental Methods of Chemical Analysis, 5th Ed. 1985.

B. Sc. (MPC & ZBC) Vth Semester

Course Code: BDCH551DSP

Course Title: Analytical Method in Chemistry Lab

Scheme of Instruction	Scheme of Examination
Total Duration: 60 hrs.	Maximum Marks: 50
Periods/ week: 4	Internal Evaluation: 15
Credits: 2	End Semester: 35
Instruction Mode: Lecture /Demonstration	Exam Duration: 3 hrs.

Course Objectives: This Unit Analytical Method in Chemistry Lab covers a wide range of topics of interdisciplinary nature. The core topics thatare part of the Units are designed to build a strong Analytical Chemistry knowledgebase in the student, and furthermore, acquaints the students with the applied aspects ofAnalytical Method. The student is thus equipped to pursue higher studies in aninstitution of her/his choice, and to apply the skills learnt in the programme to solve practicalproblems. Theseinclude various Chromatographic techniques and instruments for Electroanalytical methods.

Outcomes: Students acquire sound Practical knowledge and understanding of the fundamentalconcepts, principles and processes in Analytical Chemistry and learn quantitative Analytical Instrumentation technique. After completion of this course the students will learn

- Various Chromatographic techniques including Paper Chromatography and TLC and used it for the separation of amino acids, active ingredients of plants, flowers and juices.
- Various Electroanalytical methods including Potentiometry, pH metry and Conductometry and its applications.

BLOCK-I

1. Separation of amino acids by Paper Chromatography.
2. Separation of a mixture of Sudan Yellow and Sudan Red by TLC technique and their identification on the basis of their R_f values.
3. Chromatographic separation of active ingredients of plants, flowers and juices by TLC technique.
4. Separation of different colors from food-colored products by Column Chromatography.

BLOCK-II

1. Determination of wavelength of maximum absorption. Verification of Beer's Law for Potassium Permanganate solution and find the concentration of given unknown solution using colorimeter
2. Verification of Beer's Law for Potassium Dichromate solution and find the concentration of given unknown solution using spectrophotometer
3. Colorimetric determination of ferric iron using Potassium Thiocyanate solution
4. Colorimetric determination of the composition of Ferric Thiocyanate complex by Job's continuous variation method

Text Books and References:

1	MIT OpenCourseWare (OCW), https://ocw.mit.edu/courses/chemistry/5-310-laboratory-chemistry
2	2. CRC Handbook of Chromatography, Volume 1, Gunter Zweig, Joseph Sherma CRC Press, 1972
3	Quantitative Analysis, 6th Ed. R.A. Day Jr. and A.L. Underwood. Prentice Hall India Ltd. 1991.
4	Analytical Chemistry, 6th Ed. G.D. Christian, Jhon Wiley & Sons (Asia) Pvt. Ltd., New Delhi, 2004
5	Vogel's Text Book of Quantitative Chemical Analysis, 6th Ed. J. Mendham, R.C. Denney, J.D. Barnes, M.J.K. Thomas, Pearson Education Ltd. 2000
6	Fundamental of Analytical Chemistry, 9th Ed. D.A. Skoog, D.M. west, F.J. Holler, S.R. Crouch, Brooks Cole Cengage Learning 201
7	Chemical Analysis, Modern Instrumental Methods and Techniques, 2nd Ed. Francis Rouessac, Annick Rouessac, Wiley 2007.
8	G.W. Ewing, Instrumental Methods of Chemical Analysis, 5th Ed. 1985.

B. Sc- VIthSem- (MPC and ZBC) : Course Code: (BSCH603DST)

Course Title: Inorganic Chemistry II & Physical Chemistry IV

Scheme of Instruction	Scheme of Examination
Total Duration: 60 hrs.	Maximum Marks: 100

Periods/ week: 4	Internal Evaluation: 30
Credits: 4	End Semester: 70
Instruction Mode: Lecture	Exam Duration: 3 hrs.

Course Objectives: This course aims at giving students theoretical understanding about the Inorganic and Physical chemistry. It provides knowledge important topic of inorganic chemistry such as Transition metal Series, Coordination chemistry, Valence Bond Theory, Crystal Field Theory, bioinorganic and so on. Physical chemistry also covers the impotent such as Solid-State chemical kinetics, Catalysis and photochemistry.

Course Outcomes: On successful completion, students would have clear understanding of the inorganic and physical chemistry. Student Understand the important unite for the B. Sc. As well as for IIT JAM & UGC-Net.

Block –I

Unit 1.1 Chemistry of Elements of First Transition Series

Physico-chemical properties of the elements of the first transition series, their simple compounds and complexes. Preparation, properties, structure and uses of $KMnO_4$and $K_2Cr_2O_7$

Unit 1.2.Chemistry of Elements of Second and Third Transition Series

Physico-chemical properties of 2^{nd} and 3^{rd} transition series with reference to electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only). Difference between lanthanides and actinoids, Uses of lanthanides and actinoids.

Unit 1.3 Coordination chemistry

Difference between double salts and coordination compounds, Basic terminology of coordination compounds, Werner's theory of complex compound, IUPAC system of nomenclature (Mono nuclear and poly nuclear complexes), Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Applications of complex compounds in different fields (Analytical, Medicine, electroplating and extraction of metals).

Unit-1.4.Valence Bond Theory (VBT)

Introduction to VBT, Application of VBT to inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Paramagnetic and diamagnetic nature of complexes Drawbacks of VBT.

Block 2

Unit 2.1 Crystal Field Theory (CFT)

Introduction to CFT, Crystal field effect and crystal field splitting diagram for tetrahedral and octahedral complex. Crystal field effects for weak and strong fields. Crystal field stabilization energy (CFSE), Spectro chemical series. Factors affecting the magnitude of CFSE, Comparison of CFSE for Oh and Td complexes.

Unit 2.2. Hard and Soft acids and Bases (HSAB)

Classification of acids and bases as a hard and soft, Pearson's HSAB concept, acid-base strength and hardness and softness.Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness.

Unit 2.3 Bioinorganic Chemistry

Essential and trace elements in biological processes, metalloporphyrins with special reference to hemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{+2} and Nitrogen fixation.

Unit 2.4 Chemistry of Noble gases

Physico-chemical properties of noble gases, Reason for the existence of xenon compounds, chemistry of xenon compounds, structure and bonding in xenon compounds like XeF_2., XeF_4, and XeF_6,

Block 3:

Unit 3.1 Solid State I

Difference between crystalline and amorphous solid, Symmetry of crystal systems, Space lattice and unit cell, Types of crystal systems, Coordination number and Number of atoms in unit cell. Calculation of density and packing fraction of different types of crystal system.

Unit- 3.2 Solid State II

Laws of crystallography-(i) Law of constancy of interfacial angles. (ii) Law of rationality of indices (iii) Law of symmetry elements in crystals. X-ray diffraction by crystals.Derivation of Bragg's equation.Determination of crystal structure of NaCI, KCI and CsCI (Laue's method and powder method).

Unit 3.3 Chemical Kinetics– I:

Rate and rate Law of a reaction, Factors affecting rate of reaction, Rate constant and specific rate constant. Elementary and Complex Reactions, Molecularity, Order of Reactions. Difference between molecularity and order of reaction. Unit of rate constant for different order of reactions including nth order of reaction. Pseudo Order with reference to inversion of cane sugar and hydrolysis of ester.

Unit 3.4 Chemical Kinetics – II:

Experimental methods of determination of order of reactions. Integrated rate law for first and second order reaction. Temperature dependence of reaction rates, Arrhenius equation, Activation energy, calculation of activation energy, Numerical problem based on activation energy. Theories of Reaction Rates, Collision theory and its mechanism.

Block-4

Unit 4.1 Catalysis

Catalyst, Catalysis and Types of catalyst, Characteristics of catalysis, Theories of catalysis, Mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, Michaelis-Menten mechanism, Mechanism and kinetics of enzyme catalyzed reactions, acid-base catalysis.

Unit 4.2 Photochemistry I

Difference between thermal and photochemical process. Laws of photochemistry: Grothus-Drapper law, Stark-Einstein law, Jablonski diagram depicting various processes occurring in the excited state.Quantum yield-Photochemical reaction mechanism- hydrogen- chlorine, hydrogen- bromine reaction.

Unit 4.3 Photochemistry II

Qualitative description of fluorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions- energy transfer processes (simple examples). Basic concepts of Laser and Maser.Photochemistry of vision and colour.

Unit- 4.4 Phase Equilibrium

Statement and meaning of the terms-phase, component and degree of freedom, derivation of Gibbs phase rule; phase equilibria of one component system-water and sulphur systems. Immiscible liquids, steam distillation. Nernst distribution law, thermodynamic derivation & its applications.

Text Books and References:

1	Concise Inorganics Chemistry by J. D. Lee
2	Inorganic Chemistry by A.G. Sharpe.
3	Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993
4	Cotton, F.A. & Wilkinson, G., Advanced Inorganic Chemistry Wiley-VCH, 1999
5	Physical Chemistry, G. M. Barrow, International Student Edition, McGraw Hill.
6	Physical Chemistry, P. W. Atkins, & J. de Paula, 10th Ed., Oxford University Press (2014).
7	Advanced Physical Chemistry by Gurdeep Raj
8	Fundamentals of Photochemistry by K. K. Rohatgi.

B. Sc- VIth Sem- (MPC and ZBC),

Course Code: (BSCH652DSP)

Course Title: Inorganic Chemistry II & Physical Chemistry IV Lab

Scheme of Instruction	Scheme of Examination
Total Duration: 60 hrs.	Maximum Marks: 50
Periods/ week: 4	Internal Evaluation: 15
Credits: 2	End Semester: 35
Instruction Mode: Lecture /Demonstration	Exam Duration: 3 hrs.

Course Objectives: To train the students about how to Prepare Cu and Cu metal complexes and calculation of percentage yields. It also provides hands on experience on Qualitative inorganic analysis. Study the effect of concentration on the rate of reaction. Determination of rate constant and order of the reaction. Kinetic study of the hydrolysis.

Course Outcomes: On successful completion, students would have clear understanding of the preparation of the metal complexes. Determine the order of the reaction, students also gain knowledge ofConstruction and study of the Phase Diagram of a simple Eutectic system.

Block I:

1. Preparation and calculation of percentage yield of tetra-ammine copper (II) sulphate complex. $[Cu\ (NH_3)_4]\ SO_4$
2. Preparation and calculation of percentage yield of Sodium trioxalato ferrate (II) complex, $Na_3[Fe(C_2O_4)_3]$**.**
3. Determination of critical solution temperature of a partially miscible liquid-liquid binary mixture (phenol-water system)
4. Analysis of an unknown simple salt for one cation and one anion using systematic procedure for the qualitative inorganic analysis

Block II

1. Study the effect of concentration on the rate of reaction between Sodium Thiosulphate and Hydrochloric Acid.
2. Determination of rate constant and order of the reaction of hydrolysis of Methyl Acetate catalyzed by an acid.
3. Kinetic study of the hydrolysis of Ethyl Acetate with Sodium Hydroxide.
4. Construction and study of the Phase Diagram of a simple Eutectic system (like Naphthalene and Biphenyl or any other two components).

Text Books and References:

1	Practical Inorganic Chemistry Preparations, reactions and instrumental methods GEOFFREY PASS,
2	G. Marr and B.W. Rockett, Practical Inorganic Chemistry, Van Nostrand Reinhold.

	1972
3	Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009
4	Khosla, B.D.; Garg, V.C.; Gulati, A. (2015),Senior Practical Physical Chemistry, R. Chand & Co, New Delhi
5	Garland, C. W.; Nibler, J. W.; Shoemaker, D. P.(2003),Experiments in Physical Chemistry, 8th Edition, McGraw-Hill, New York.